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Managing airport charges under the multiple hub network with high speed rail: Considering capacity and gateway function

Mikio Takebayashi

Graduate School of Maritime Sciences, Kobe University, 5-1-1 Fukae-minami, Higashi-nada, Kobe 658-0022, Japan

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ABSTRACT

This paper aims to identify a better way of managing airport charges to improve social welfare. In particular, we consider the system of two hubs that connect high speed rail (HSR). We apply the bi-level air transport model, which includes the behavior of carriers, passengers, and airports. We analyze various scenarios of airport charges in hub airports. The results suggest that (i) maximization of airports' profit by coordinating airport charges can be compatible with the improvement of social welfare under the multiple hub system, when the runway capacity constraint at a busy airport is not strict, but that situation exists under a particular charging scheme; (ii) considering the profitability, there exists definite though limited possibility of cooperation between airlines and HSR.

1. Introduction

1.1. Background

Improving airport performance—including reducing congestion of aircrafts and gaining traffic of both aircrafts and passengers—is an important issue. It is often achieved by significant investment, such as runway construction. However, the construction of new runways is fraught with difficulties, including acquiring a site for the new runway and coping with noise damage. For airports located close to business districts, like Haneda Airport in Tokyo, of which inbound demand is rapidly increasing, it is difficult to construct new runways. Therefore, we need to find other ways for improving airport performance.

One possible way is to consider a multiple airport system. In a metropolitan area like Tokyo, the multiple airport system is often recognized to be composed of one or two congested airports and nearby non-congested airports. The demand is concentrated in congested airports, which often leads to problematic conditions such as flight delay. On the other hand, the facilities of non-congested airports are often used inefficiently. Thus, the problem of managing a multiple airport system concerns the problem of maintaining a proper balance between congested and non-congested airports. However, if all airports in the same area are congested, the multiple airport system in the area does not work and another solution will be necessary.

In 2014, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan announced a national long-term development plan, "Grand Design of National Spatial Development towards 2050" (henceforth Grand Design 2050) (MLIT, 2014). MLIT defined the "Super Mega-Region," which covers the wide area from the Tokyo Metropolitan Area to the Osaka Metropolitan Area, connected by the super high speed rail (Linear Shinkansen) as a future image of national backbone, with gateway airports located at either end of the region. Super Mega-Region is expected to actualize twenty years later, but the runway capacity of two airports in the Tokyo Metropolitan Area (i.e., Haneda and Narita) is becoming tight and expanding it is difficult. Thus, improving the airport performance of Haneda and Narita is a crucial issue in Grand Design 2050. One strong candidate solution is to directly connect the non-congested

E-mail address: takebaya@kobe-u.ac.jp.

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airports (secondary/reliever airports) to other rapid transport, such as the high speed rail (HSR), which can serve as a feeder service for international flights. Henceforth, we call this system "multiple airport system with HSR."

At the same time, HSR has been well developed and has become a competitor of air transport (Dobruszkes, 2011; Fu et al., 2012). In order to make the multiple airport system with HSR a feasible solution, a cooperative—not competitive—relationship will need to be fostered between air transport and HSR. Furthermore, finding an effective management of this system will be useful for other countries now or in the future, such as in China, EU, and the US.

1.2. Literature review and research purpose

Some research has addressed the above-mentioned issues through different approaches. Mun and Teraji (2012) described the problems related to both allocating international and domestic services to two airports and setting the charge simultaneously. They concluded that (i) the number of allocated services to the airport decreases when the distance between the airport and city decreases, and (ii) the charge-setting regulation is effective for improving social welfare. Takebayashi also made similar suggestions regarding service allocation under the serious capacity constraint at busy airports (Takebayashi, 2012). These studies examined the management of multiple airport systems in small regions, but it is necessary to expand beyond this analysis and consider the multiple airport system with HSR, which connects two separate regions, in order to relieve the congestion at the big hub airport and enhance the total performance of airport system without large investment.

The relationship between air transport (or airport) and HSR has been analyzed in the last few years. As previously mentioned, HSR has been regarded as a competitor of air transport. Dobruszkes (2011) conducted an empirical analysis between air transport and HSR in the EU and revealed the rivalry between the two. Fu et al. (2012) pointed out that HSR has been dominant in some markets in mainland China. On the other hand, recent studies suggest the possibility of cooperative relation between air transport and HSR. Jiang and Zhang (2014) examined the usefulness of airline-HSR collaboration and concluded that the serious shortage of airport capacity would be supplemented by the collaboration between air transport and HSR. Takebayashi offered similar policy implications from the research of airport-HSR cooperation (Takebayashi, 2016a). He also discussed the feasibility of airline-HSR cooperation (Takebayashi, 2014) and concluded that airlines would have considerable incentives for the airline-HSR cooperation, but it would be difficult to obtain HSR's cooperation. These studies offered excellent suggestions about the coexistence of air transport and HSR, but unfortunately little research exists on airport management itself in conjunction with HSR. In particular, we need a suitable method of airport pricing, a crucial element in airport management that concerns the improvement of both airport profitability and social welfare. Many studies have made useful policy suggestions[1] (see, for example, Oum et al., 1996; Zhang and Zhang, 2001; Oum et al., 2004), and some have also considered the competitive situation among airports (De Borger and Van Dender, 2006; Basso and Zhang, 2007).

Regarding airport pricing, airports often face serious problems related to their physical conditions such as runway capacity constraint. Zhang and Zhang (2003) and Basso (2008) considered this and theoretically discussed the difference in airport pricing between airports focused on profit maximization and airports focused on welfare maximization in the oligopolistic airline market. They argued that, for a given capacity, the charge of airports aiming to maximize profit is higher than that of airports aiming to maximize welfare. Their analysis was based on the plausible assumption of airport competition, but their analysis is limited to airport charges imposed on airlines.[2]

Although the importance of concession revenues is increasing, the landing charge imposed on airlines and the terminal charge imposed on international travel passengers are still regarded as important sources for airport revenues. This charge structure is common in Asia, including Japan, but the organization of these charges is rarely discussed. Each charge, of course, has different effects on the market, which can be a decisive point for airport management. Czerny and Zhang (2015) conducted an analytical work from a theoretical point of view, making a comprehensive analysis to obtain the optimal per-flight and per-passenger charges for one airport and discussing the response of airlines to the change of charges. Wan et al. (2015) proposed a theoretical approach to consider the optimal airport charge, which consists of landing charge and terminal charge as the congestion pricing. They dealt with two types of congestion, runway congestion and terminal congestion. They obtained the optimal airport charge reflecting the effect of runway congestion and terminal congestion and discussed the features of the optimal airport charge for airlines and passengers. On the other hand, a market with two types of charges can be regarded as a "two-sided market,"[3] which is adopted in a number of studies in air transport (Gillen and Mantin, 2013; Unami et. al., 2013). They revealed some important observations about airport charges, but they did not consider the multiple airport system. As for the Japanese market, the future structure of transport backbone described in Grand Design 2050 is much more complicated: two hubs can be connected by HSR, but one of them may suffer from a serious capacity constraint. Reducing the demand of over-concentrated big hub is desirable for the efficient performance of airport system. When we implement the appropriate demand allocation to each hub, an effective collaboration between air transport and HSR is important. To achieve a better balance between air transport and HSR, we need policy revisions to manage the airports in this complicated situation.

In light of this background, our purpose in this research is to examine the management of airport charges to identify a better way of attracting more traffic flow and improving social welfare under the two-hub system connected by HSR. In particular, we consider

[1] The comprehensive literature review was provided by Zhang and Czerny (2012).

[2] Zhang and Zhang (2003) dealt with the price of concession paid by the passengers, but this charge is not directly associated with the passenger flow itself.

[3] The theory of two-sided market was proposed by Rochet and Tirole (2003).